

-1-

METHOD AND DEVICE FOR RETRIEVING CUSTOMIZED MOVING IMAGE DATA
FROM A REMOTE SOURCE

AND A MOVING IMAGE DATA SOURCE FOR REMOTE RETRIEVAL

5 The present invention relates to a method and device for
retrieving customized moving image data (i.e. videos, movies,
animations, etc., hereinafter referred to as video data) from a
remote source and a moving image data source for remote
10 clips, animations or entire video films (movies), for instance
in the case of video-on-demand.

It is known how to provide digital video data over a
network for access by remote users. However, previous systems
have a number of drawbacks. In particular, video data files
15 are typically very large and, hence, take a considerable amount
of time to download over a network such as the Internet. Their
large size may also make them inconvenient for use with the
small processor memories or limited data storage capacities of
many user terminals. Furthermore, video data files are often
20 provided on network servers in a format which may be
inappropriate for many user terminals or for the intended end
use.

According to the present invention, there is provided a
method of retrieving customized video data, the method
25 comprising:

- (a) specifying a particular video data file and
requesting an image of video data and information
concerning the video data;
- (b) retrieving from the source the image of the video
30 data and the information concerning the video data;
- (c) specifying parameters determining at least one of the
desired spatial, temporal and format characteristics
of the customized video data and sending the
parameters to the source; and
- 35 (d) receiving video data transmitted by the source after

-2-

customization on the basis of the specified parameters.

According to the present invention, there is also provided a device for retrieving customized video data from a remote source, the device including:

- (a) means for specifying a particular video data file and requesting an image of video data and information concerning the video data;
- (b) means for receiving from the remote source the image of the video data and the information concerning the video data;
- (c) means for transmitting parameters determining at least one of the desired spatial, temporal and format characteristics of the video data and for requesting customization of the video data on the basis of the specified customization parameters; and
- (d) means for retrieving video data supplied from the source after customization on the basis of the specified customization parameters.

In conjunction with this method, there is also provided a video data source for remote access, the source:

- (a) being responsive to a remote user's selection of a particular video data file to prepare an image of video data and information concerning the video data,
- (b) transmitting to the user the image of the video data and the information concerning the video data,
- (c) being responsive to parameters determining at least one of the desired spatial, temporal and format characteristics of the video data received from the remote user, and
- (d) transmitting to the user video data from the original video data file after customization on the basis of the received parameters.

Once a user terminal has accessed the source, the source can transmit to the user a control program to enable the user

-3-

to specify the customization parameters. The control program may take the form of a Java applet. In this way, the user terminal does not in itself require any features dedicated to the remote source, but acquires the ability to control the
5 source upon accessing it. The source can be used by several remote users concurrently.

The specifying parameters may specify merely default or unmodified video data or may specify customization of the video data. Furthermore, the specifying parameters may additionally
10 determine one or both of auditory and visual characteristics.

The customized video data may include one or more of the following characteristics:

- (i) one or more temporal extracts from the original video data or the full original length,
- 15 (ii) one or more spatial extracts from the original video data or the full original frame size,
- (iii) a magnification or demagnification (zooming or dezooming) of the original video data or the unmodified original dimensions,
- 20 (iv) a time lapse ratio relative to the original video data where this value may be unity,
- (v) a selection of one or more of the soundtracks from among those accompanying the original video data or the omission of soundtrack data,
- 25 (vi) a modification of the visual appearance of the original video data by the application of selected image processing procedures or no change to the visual appearance,
- (vii) encoding of the video data using a selected
30 video format that may be the same as that of the original video data,
- (viii) encoding of the video data using a specified frame rate that may be the same as that of the original video data,
- 35 (ix) encoding of the video data using a selected

-4-

compression/decompression algorithm (codec) that may be the same as that of the original video data, and (x) encoding of the video data using a selected compression quality setting that may be the same as that of the original video data.

The present invention permits the user to customize a personal version of a particular video data file available on a network server or on an Internet server prior to downloading it, hence permitting the video to be adapted to suit the bandwidth of its network connection, the available data storage capacity, the video playback software available on the user's computer, or the subsequent usage to which the video will be put.

Specifically, the present invention makes it possible to edit a selected video data file spatially and temporally, to modify the magnification and the time lapse ratio of the customized version, to select the soundtracks, to modify the visual appearance of the original video data, and to change the video format, the frame rate, and the nature and quality of the compression applied to the customized video data, prior to downloading to the user. In this way, the video quality and playback characteristics can be matched to the intended use to which the video will be put, and substantial savings in download time and data storage requirement may be obtained.

This may be advantageous for the user.

For example, in some cases a user may require only part of the full video temporal sequence, perhaps only the first half, or may require only part of each video frame, for instance only the bottom right quadrant. By specifying such customization parameters to the source, which modifies the video data in response to them before transmission to the user, unnecessary data is not transmitted over the network. In consequence, both the transfer (downloading) time and the video data file size may be reduced, the latter thus requiring less data storage space on the user terminal. This is particularly useful if the

user terminal has a small processor memory and/or limited data storage capacity.

Rather than downloading an entire video data file and then edit and process it locally, a user merely requests the customization of the video data required, leaving the computational burden for the video editing and customization processes to the source, such that a relatively unsophisticated remote user terminal with limited processing power can obtain a video data file edited as required, without the need for any local video editing capabilities.

Thus, using the present invention, a user can download only that part of a video which is of interest, either in temporal or spatial terms. Similarly, the user can download the video data with the image quality or format to suit the user terminal or application.

If, for example, the viewer wishes to download and view an entire video for which a version in streaming format is not available, but has only a low-speed network connection and limited data storage capacity, a highly compressed and spatially demagnified (dezoomed) version might be chosen to enable rapid Internet transmission and uninterrupted viewing at full frame rate.

Alternatively, if the video is to be downloaded for subsequent local projection, the projectionist will wish to ensure that it is downloaded in full length and at full frame size, with the highest possible quality compatible with the real-time video display bandwidth of the local video server, even if this means a prolonged downloading processes that may be conveniently performed overnight.

30 If the purpose is instead to undertake frame-by-frame
image analysis of a few particular events, in order to quantify
35 particular features in the images, then it may be desirable to
download only particular areas of interest within selected
temporal video clips from the original video data file, but to
do so at the highest possible resolution.

-6-

The present invention will be more clearly understood from the following description, given by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates schematically an embodiment of the
5 present invention on a network;

Figure 2 illustrates schematically an alternative embodiment of the invention on a network;

Figure 3 illustrates the control panel of a user terminal operating according to an embodiment of the present invention;
10 and

Figure 4 illustrates another control panel of a user terminal operating according to an embodiment of the present invention.

As is well known and as is illustrated in Figures 1 and 2,
15 a number of user terminals 2,4,6 may communicate with a server 8 over a network 10. In particular, it is possible to provide the user terminals 2,4,6 and the server 8 with connections to the Internet 10, such that they may communicate over the Internet 10.

20 The server 8 may provide many different services to the user terminals 2,4,6. One very common use of a server 8 is to provide information. The information provided may include many different types of data, including text, sounds and images. The present application is particularly concerned with the
25 provision of digitized moving image data (i.e. videos, movies, animations, etc., herein referred to as video data). The server 8 may store the video data itself or may handle video data stored on another server at a separate location 12 (Figure 2). In the latter case, the video data may be transferred to
30 the server 8 from another server at a separate location 12 by a dedicated line or, as illustrated in Figure 2, via a network or the Internet 10.

It is now proposed to provide a system based on the server 8 and the user terminals 2,4,6 which enables editing and
35 customization of specified video data files to be undertaken on

-7-

the server 8 by remote users, and for the resulting customized video data file to be downloaded from the server 8 to the user terminals 2,4, 6. In particular, the system is intended to allow only desired spatio-temporal portions of particular video files to be downloaded, and to allow the edited video data to be downloaded with a specified magnification, time lapse ratio and visual appearance, with selected soundtracks, and with a specified video format, frame rate, codec and compression quality setting.

10 The preferred embodiment to be described below is called *VIDOS*, since the present invention in a *Video Download Specification* system. The preferred embodiment described as *VIDOS* may be written as a platform-independent Java server program running on a *VIDOS* server, together with Java applets
15 running on the user terminals by which the users can select the required video data files and specify the parameters to be used in preparing the customized versions of these files. Although other methods of implementing the invention are possible, Java is a form of programming that is particularly well suited for
20 interactive work over a network or the Internet. The server 8 preferably stores the Java server program and Java user applets relating to the video selection and customization. When one of the user terminals 2,4,6 accesses the *VIDOS* server 8, the appropriate Java applet is sent to the particular user terminal
25 2,4,6 and this enables the user terminal 2,4,6 to send appropriate parameters to the server 8, first to specify the selected video data file and subsequently to customize the video data prior to downloading. More specifically, it permits the user to enter the parameters required to customize
30 a personal edited version of a particular video data file, to be informed of the consequences of these parameter choices in terms of the compression time and final video file size, and to see a preview of the first 50 frames of the customized version prior to final downloading of the complete customized video.

-8-

On-line help may be available to guide the naïve user in making these choices. All the parameters have initial default values, and, in case of incompatibilities in the choices made, the program may inform the user and offer appropriate alternatives.

5 The video customization parameters may be passed over a network or the Internet, for example using standard World Wide Web protocols, to the main *VIDOS* server program running on the distant server. The server may operate using the Java program together with standard programming tools and libraries to
10 produce the desired customized version of the video. It may then send a message to the user terminal, providing the user with access to the customized video data and permitting the user to initiate the customized video downloading process.

15 The nature of the Java *VIDOS* server program is such that several user terminals 2,4,6 may undertake concurrent customizations of different video data files.

20 The working of the present invention will now be described in greater detail. Upon first accessing the server 8, each user terminal 2,4,6 preferably presents to the user a control panel (the video selection interface), such as is illustrated in Figure 3. The user is first asked to specify the name and location of the video data file to be edited, which may be stored on the *VIDOS* server 8 itself or on another server at a separate location 12. Once this file has been located and, if
25 necessary, transferred to the *VIDOS* server 8, an image of the video data is prepared by the server and transmitted to the user terminal. This may take the form of a still image of the first frame of the chosen video data file, as in the example illustrated in Figure 3, or it may comprise downloaded or
30 streamed moving image data of reduced preview resolution, with appropriate viewing controls. The server preferably also transmits to the user terminal textual data relating to the size and format of the full video data file as stored by the server 8 or obtained from another server at a separate location
35 12. The user may at this stage choose simply to download the

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-9-

entire video file in its original format, or alternatively may choose to make use of the *VIDOS* system to create a customized version of the original video data prior to downloading it.

Having selected use of the *VIDOS* video download specification system, the user terminal presents the user with a second control panel (the video customization interface), such as is illustrated in Figure 4. Once again, an image representative of the video data is displayed in the upper portion of the control panel, and controls are provided whereby the user is able to enter customization parameters.

In entering the customization parameters, the user can first determine the spatial extent of each video frame to be downloaded. By default, this is the full frame, but, as shown in the example (Figure 4), the user can interactively limit the spatial region of each frame to a particular rectangular area of interest (AoI). The dimensions of this may be defined in a number of ways: for example by using mouse clicks on the displayed image of the video data to identify the upper left and lower right corners of the AoI box; by typing the cropping values in the four text boxes (left, right, top and bottom) immediately below the video image; or by increasing or decreasing the values in these boxes using the adjacent + and - spinner buttons. In whichever way the user chooses to specify the AoI, the selected area is preferably displayed by an outline on the illustrated image of the video data (Fig. 4). It would alternatively be possible to select more than one area of interest, and to position several areas of interest in different ways in the final video frames.

A magnification/ demagnification (zoom/dezoom) parameter may also be specified. In the illustrated control panel (Figure 4), this is the right-hand box on the top row. Taking account of this zoom factor, the cropped original frame size and the resulting download frame size are interactively displayed in the adjacent area. In addition, the file size of the output video after such spatial editing and an estimate of

-10-

the conversion time required to generate the customized video may be indicated (as is illustrated near the bottom of Figure 4). These values may also be interactively updated as the AoI cropping parameters and the other download customization parameters described below are modified.

As illustrated in Figure 4, in addition to the controls specifying the spatial constraints to be imposed on the original video data prior to downloading, it is also possible to provide similar controls by which the user can undertake temporal editing of the original video data. The default values include the whole of the original video. The system preferably enables the user to select one or more temporal sections (video clips) from the original video data, and to arrange such video clips, if more than one, in a specified sequence in the final customized video. In the example shown in Figure 4, by using controls to enter the first and last frame numbers, the user is able to specify the time points in the original video that will become the beginning and end of the customized video. The system preferably enables the user to view the frames to be chosen for the start and end times of each video clip, for example by positioning sliders on a video time-line display control.

The system preferably enables the user to specify a time lapse ratio between the original and the customized video data, which if other than unity enabling the user to view events either in slow motion or speeded up relative to the original.

If the original video has a sound track, a control is preferably provided to make it possible to specify whether or not this should be included in the customized video. Such selection can be extended to the choice of one or more particular soundtracks from several original soundtracks, for example multiple language soundtracks, or the omission of the soundtrack data altogether.

One can also preferably alter the visual appearance of the original video data by applying simple image processing

-11-

procedures such as contrast enhancement, smoothing or sharpening, pseudocolouring, etc.

Once the spatial, temporal, auditory and visual parameters have been specified, the user may then use further controls to specify other customizing parameters. As illustrated, drop-down list boxes are provided to specify the customizing parameters that relate to the desired video encoding. The first of these preferably specifies the video format to be used, with a choice between several commonly-used industry standard digital video formats such as AVI (Audio Video Interleave), QT (Quick Time) or MPEG-1. The second is for the video frame rate, for example either 10, 15, 20, 25 or 30 frames per second. Then comes the choice of the codec to be applied to the video, for example Cinepak, Indeo, Motion-JPEG, MPEG-1 or other industry standard codecs, with these choices preferably being automatically adapted to the initial choice of video format, as appropriate. The user can then specify the compression quality setting, for example choosing between 'Uncompressed' (not available for certain formats such as MPEG-1), 'Low', 'Medium' or 'High' (which may correspond to bit rates of 579,000, 1,158,000 and 2,316,000 bits per second for MPEG-1, or to values of 0.3, 0.6 and 0.9 for the spatial quality setting of other codecs).

As mentioned above, all of these parameters preferably have initial default values. If incompatible choices are made, the system preferably informs the user and offer appropriate alternatives. Every time a parameter choice is made, the displayed estimates of the final video data file size and conversion time can be automatically updated. These estimates may be determined from a data table derived from prior test video data conversions undertaken on the particular hardware upon which the VIDOS server program is running, under the full range of possible compression conditions, the actual conversion times obviously depending on the performance of the server on which the system is running and the number of concurrent users.

-12-

In the light of the feedback provided by the *VIDOS* server, the user may revise the input customization parameters. The system preferably provides a Preview control for use once the user believes that the customization parameters have been

5 optimized for the required purpose. As illustrated in Figure 4, such a Preview button is provided at the foot of the *VIDOS* video customization interface screen. This preferably activates the customization of the first section of the video, for example the first fifty frames, which is then downloaded

10 and displayed on the user terminal. In this way, the user is given the opportunity to make a final quality assurance check, to ensure that the customized video will have the required appearance and characteristics, before the customization parameters are applied to the entire video data file. At this

15 stage, the customization parameters can be further revised, if desired, until the preview is acceptable.

Finally, the system allows the user to activate the server to undertake the complete customization of the original video data according to the final customization parameters, and then

20 to download the customized version of it to the user terminal. As illustrated, a Convert button may be provided at the foot of the *VIDOS* video customization interface screen. This may be clicked to activate the *VIDOS* server program to generate a full customized downloadable file with the precise specifications

25 requested, containing just the required portions of the original video data in the desired format. The user may already know the time that this conversion is likely to take, having been advised of this at the foot of the *VIDOS* video customization interface screen. Depending upon the length of

30 the original video, the nature of the customization requested, the computing power of the server, and the number of concurrent users, the conversion process take from a few seconds to several minutes. When this task is complete, the *VIDOS* server preferably sends a message to the user terminal confirming that

-13-

the customization process has been completed, giving the compressed size of the customized version of the video, and providing a link to the customized video file itself, whereby the user may initiate the final downloading process.

5 In conclusion, once a particular video data file has been identified on a network server or an Internet server, the present invention permits the user to edit and customize the video data from a distance over the network, without having first to download it in its entirety onto the user terminal, by
10 specify the desired spatial, temporal, auditory, visual and format characteristics of the customized video data. One advantage of this is that the network-based video editing may be achieved without the need for the user to possess video editing software on the user terminal. By limiting the spatial
15 or temporal extent of the video data to be downloaded, or by choosing a more efficient data compression system, the size of the customized video data file may be made very significantly smaller than that of the original video data. This capability may be used to improve the speed of network transfer of the
20 video file, which is particularly important when working over low bandwidth network connections such as modems or satellite links. It may also be used to achieve substantial savings in data storage requirements on the user terminal, or to adapt the video data quality and format to suit the playback
25 characteristics of the user terminal or the intended use to which the video will be put.

The present invention has many potential uses. For instance, such network-based video editing would allow regional members of a TV network to download from a central video data
30 repository particular portions of news items and other material relevant to their particular regions. Similarly, video clips may be selected from an archive and tailored for inclusion in live or computer-based professional training programs, for example in the nursing profession or for aircraft maintenance,
35 and school teachers and university lecturers would be able to

select video segments, for example of particular twentieth century historical events from a national film archive, to illustrate their own classes and lectures. As the use of networked digital video databases increases, the ability to
5 manipulate video data in this way will become ever more important.

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